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Final Report - Space Station Furnace Facility Management Information System (SSFF-MIS) Development

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Final Report - Space Station Furnace Facility Management Information System (SSFF-MIS) Development

This report summarizes the chronology, results, and lessons learned from the development of the SSFF-MIS. This system has been nearly two years in development and has yielded some valuable insights into specialized MIS development.

General:

In December of 1994, the Camber Corporation and Science Applications International Corporation (SAIC) were contracted to design, develop, and implement a MIS for Marshall Space Flight Center's Space Station Furnace Facility Project. The system was to be accessible from both IBM-Compatible PC and Macintosh platforms. The system was required to contain data manually entered into the MIS as well as data imported from other MSFC sources. Electronic interfaces were established for each data source and retrieval was to be performed at prescribed time intervals.

The SOW requirement that predominantly drove the development software selection was the dual-platform (IBM-PC and Macintosh) requirement. The requirement that the system would be maintained by Government personnel influenced the selection of Commercial Off-the-shelf software because of its inherent stability and readily available documentation and support. Microsoft FoxPro Professional 2.6 for Windows and Macintosh was selected as the development tool. This is a software development tool that has been in use for many years. It is stable and powerful. Microsoft has since released the replacement for this product, Microsoft Visual FoxPro, but at the time of this development, it was only available on the Windows platform.

The initial contract included included the requirement for capabilities relating to the Work- and Organizational Breakdown Structures, cost (plan and actuals), workforce (plan and actuals), critical path scheduling, trend analysis, procurements and contracts, interface to manufacturing, Safety and Mission Assurance, risk analysis, and technical performance indicators. It also required full documentation of the system and training of users. During the course of the contract, the requirements for Safety and Mission Assurance interface, risk analysis, and technical performance indicators were deleted. Additional capabilities were added as reflected in the Contract Chronology below. Modification 4 added the requirement for Support Contractor manpower data, the ability to manually input data not imported from normal sources, a general "health" indicator screen, and remote usage. Mod 6 included the ability to change the level of planning of Civil Service Manpower at any time and the ability to manually enter Op Codes in the manufacturing data where such codes were not provided by the IMPACS database. Modification 9 included a number of changes to report contents and formats. Modification 11 required the preparation of a detailed System Design Document.

Contractual Chronology:

Description	Contract Value	Contract Funded
Dec. 8, 1994 Contract Signed	$600,738	$587.496
Jan. 19,1995 Mod 1 - Fully funded Contract	$600,738	$600,738
Mar. 6, 1995 Mod 2 - Add 533Q reporting requirement	$600,738	$600,738
Feb 20, 1996 Mod 3 - Additional Funding	$675,738	$675,738
Mar. 22, 1996 Mod 4 - Additions/Deletions	$725,738	$725,738
May 3, 1996 Mod 5 - Additional Funding	$776,256	$776,256
May 20, 1996 Mod 6 - Change Organizational level of Civil Service W/F, Input OP Codes	$797,858	$797,858
Jun 7, 1996 Mod 7 - Period of Performance extension		
Jun 14, 1996 Mod 8 - Increase in Provisional Estimated Costs	$845,907	$845,907
Jul 25, 1996 Mod 9 - Report Changes, SC by ABS, ABS Personal View, Variance by COG, Yearly Name Run changes, etc.	$910,879	$910,879
Sep 23, 1996 Mod 10 - Added $1,828 Fee for the Mod 8 increase of $48,049		
Sep 26, 1996 Mod 11 - Document	$946,333	$946,333
Oct 7, 1996 Mod 12 - Additional Funding to Cover Change Order No.4, Camber's Proposal Dated Oct. 4, 1996.	$989,578	$989,578

We realized our mistake in not reflecting any actual or anticipated extra work on our 533 submittals after the 11/18/95 submissions. Our December, 1995, 533 Report showed Total Cost of $751,090, or an increase in cost of $108,935. $96,112 of the $108,935 was money already spent on items requested by the client, but not in the statement of work. These items were Aggregate Breakdown Structure (ABS) capability - $27,267, Automated Schedule Consolidation - $41,648, Health Screen - $7,009, and Additional scheduling support provided for 3.5 months after the logically integrated baseline schedule had been delivered - $20,188.

Our January 1996 533 Report showed an increase in cost of $5,768 to $756,858. This increase was for the extra month of scheduling support provided. At this time, we were requesting the Program Office to state formally whether or not they wanted continued scheduling support. Their response was that they had always "expected" scheduling support until the MIS would provide an automated scheduling capability.

Our February 533 increased to $841,559. This represented an additional $84,701 from the previous month. We attached some points of clarification to explain the increase. Approximately $18,342 was to continue providing scheduling support, at a reduced level, from the first of March, through the end of June. It was also becoming clearer that the requirement associated with IMPACS included interfacing the IMPACS data with Microsoft Project schedules. This was the difference between our "Minimum" and "Maximum" estimates. Prior to this 533, our estimates had been based on the Minimum number; this 533 reflects the Maximum cost for an increase of $19,487. The requirement to allow inputs of Support Contractor Workforce, Plans and Actual, was included in this 533, an increase in cost of $14,259. Additional efforts spent clarifying the SOW and preparing a detailed Implementation Plan trying to clarify the requirements were included; this represented approximately $20,000 of actual cost

already spent in the December - January time frame (at the behest of MSFC Contracts during the December 14 Contract discussion meeting). Annualized reports were also included at a cost of $12,613. At this point, the 533 still included the deletions we were expecting in an upcoming contract mod (mod 4).

Our March 533 showed a estimate at completion of $776,256, a decrease of $65,303. This amount is very close to the net of deletions and additions included in Mod 4 ($66,427).

This value to complete remained the same until the May 533. An increase of $69,652 was included to bring the total to $845,908. This value tracks with the activities of Modifications 6-8.

Our July 533 increased the cost to $910,879, an additional $64,971. These changes were included in Modification 9.

All of our discrepancies revolve around the initial changes from December, 1995 through March, 1996. In this time, our estimate at completion went from $600,738 to $776,256, a delta of $175,518. This delta includes the net deletion of $66K involved with Modification 4. Thus, there is an additional $241.5K not clearly identified in any of the mods. Much of this was included in our Constructive Change proposal. These additions are:

ABS	$27,267
Automated Schedule Consolidation	41,648
Initial Health Screen	7,009
Additional Scheduling Support	62,006
Automated Schedule Consolidation (after Dec. 1995)	10,252
Project Management	49,794
Overrun	43,969

Technical Chronology:

The following events represent the chronological highlights of the contract:
December, 1994 -- Contract awarded 8 December 1994. Conducted contract kickoff meeting with project personnel 12 December 1994. SSFF personnel provided Camber with documentation from baseline review in August 1994. Camber reviewed that information for insight into structuring information for MIS. Met with Monica Hammond of SSFF office to review existing project schedules 21 December 1994.

January, 1995 -- January 6, met with Bill Taylor, Project Manager, to discuss specific functions and formats which he desires in MIS. Also met with Rosemary Finley and Sharon Wright for same purpose. Had several in-house dialogues regarding modular definition of MIS, hardware and software requirements, etc. January 20, participated in all-day Project Review, continued into Monday, January 23. Continued dialogue with Andy Linskey regarding access to MSFC databases. Also discussed need to identify a single ISO point of contact. Friday, January 27, met in Andy Linskey's office with Mr. Irv Sainker of ISO (our designated point of contact) to discuss hardware and software requirements of MIS, interface to MSFC LAN, procedures, nature of this contract, etc.

Scheduled meetings with several WBS managers to review schedules and elicit requirements for MIS design. These meetings were scheduled for early February, prior to the delivery of the MIS Design Requirements Document and Implementation Plan.

February, 1995 -- February 1, conducted interviews with the following SSFF team members for input to system design:

Terry Koelbl -- DSMI
Joseph McConnell -- Thermal Systems
Larry Davis -- Electrical Integration
Mike Stallcup -- Structural Analysis

February 8, participated in all day Monthly Program Review. Also delivered Space Station Furnace Facility MIS Design and Implementation Plan on schedule. February 17, delivered hardware for on site MIS development workstation. February 22, attended Senior Management Review. Delivered FoxPro for Windows for installation on on-site development workstation.

During February, 1995, the Camber/SAIC team completed the table designs for tables related to the workforce and funds modules, including the WBS/UPN related table. We determined the output reports expected to be needed from the system, including report names and contents. We had discussions on alternatives for the menu design of the overall system.

We were provided eight schedule files by WBS managers for incorporation into the merged and integrated project schedule. Seven remained to be delivered and were expected during March.

March, 1995 -- 15 March, Received individual schedules from WBS managers (with the exception of Materials & Assembly, Operations, Safety & Mission Assurance, Project Management, and Systems Engineering) which reflected 8-25-94 baselines and revisions through mid-March. 20-21 March, Reviewed screen designs for input of plans with both A. Linskey and R. Finley prior to coding design in FoxPro. 22 March, Completed merging of the WBS schedules into a single Microsoft *Project* file. This effort served to prove that files delivered to schedule integration in different formats and "views" could be successfully merged. 23 March, Advised the Program Manager that we had certain concerns regarding Microsoft *Project's* capabilities to support the total schedule integration and reporting for SSFF. This concern centered around two issues:

1) The level of WBS indenture in MS *Project* is restricted to 10. Some WBS managers had already taken their WBS indenture to level 12.
2) The graphics flexibility of *Project* might not support the preferred schedule format of the SSFF Program Control Manager.

25 March, Received first set of updates to WBS Managers' schedules which reflected the dates contained in the 95-1 POP. Ordered no-cost evaluation copies of TimeLine for Windows v.6.1, and Micro Frame's Project Server to evaluate their appropriateness for overcoming the above-mentioned limitations in MS *Project*. Initiated procurement of network server hardware and software for on site MIS, so introduction of modules to users might begin in April.

April, 1995 -- 1-10 April, Received evaluation copies of Primavera Project Planner and TimeLine v.6 for evaluation as possible integration tools for total project schedule. 1-30 April, Worked extensively one-on-one with WBS Managers in improving the quality of their schedules and the increased use of internal logic in their Microsoft *Project* files. 20 April, Met with Andy Linskey to review revised schedule aligned along lines of contract SOW. He approved of the approach, although the schedule needs to be further detailed in a couple of areas. Continued

code development in preparation for the first demonstration of the SSFF MIS in early May (Scheduled for 5 May, 1995).

May, 1995 -- 1-31 May, Evaluated Primavera Project Planner and TimeLine v.6 for possible integration tools for total project schedule. 1-31 May, Continued to work extensively one-on-one with WBS Managers in improving the quality of their schedules and the increased use of internal logic in their Microsoft *Project* files. 5 May, Conducted demonstration of Alpha version of SSFF MIS for Andy Linskey and other SSFF staff members. Received comments for incorporation into initial release. Currently anticipate delivery of first release to selected personnel on 1 June. 15-26 May, Tested Alpha release of SSFF MIS and corrected problems in preparation for delivery to NASA. 25 May, Met with Andy Linskey to review schedule format and status for inclusion in revised Implementation Plan. Revision to plan is currently projected for 1 June.

June, 1995 -- 2 June, Delivered initial version of SSFF MIS, which included the "Plan Entry" function for both workforce and funds. Installed this on A. Linskey's and R. Finley's machines. Checked out general function and made sure print function operated. 6 June, Delivered end-of-May MARTS and WIS data, installed on A. Linskey's and R. Finley's machines. 20 June, Delivered copies of preliminary user documentation. 22 June, Met with personnel of both ISO and CSC to discuss location and eventual turnover of the server to be used for the SSFF MIS. Tentatively decided to locate the server in a central location in Building 4207 where CSC currently maintains several servers. The "maintenance" on this server will then be subdivided into hardware and application software maintenance (upgrading software, performing backups, etc.) and MIS maintenance (importing and validating data, controlling security and new users, etc.). CSC would eventually take over the server maintenance. Someone in the SSFF P.O. will eventually take over the MIS maintenance function. 26 June, Several Team members participated in Windows NT training. 27-30 June, Had several discussions with A. Linskey, M. Hammond, and W. Taylor regarding the schedule module within the MIS, the relationship between Microsoft Project and the rest of the MIS, and schedule integration procedures. We had not yet reached agreement on the ideal approach to these issues. This was a complex set of issues, involving the distribution of responsibility for maintaining portions of the SSFF schedule, the need for an integrated critical path analysis, the need for compatibility with both Macintosh and IBM PC's, baseline schedule control, configuration management of the schedule(s), and a shortage of personnel in the Program Office to serve as the schedule coordination function. Throughout the month, several data anomalies which were noted in the May report were resolved. Server hardware was now being used at Camber's location.

July, 1995 -- 10 July, Delivered updated executables and End-of June MARTS and WIS data, installed on A. Linskey's and R. Finley's machines. 11 July, Completed design and began implementation of security process within development MIS. 13 July, Conducted further schedule discussions with A. Linskey, M. Hammond, and W. Taylor regarding the schedule module within the MIS, the relationship between Microsoft Project and the rest of the MIS, and schedule integration procedures. Mr. Taylor reemphasized his desire for as much automation of the process as possible. We agreed to look further at the possibilities and to meet again on 1 August to advise him what is possible. 14 July, Completed test plan. Completed implementing multi-user capability. 21 July, Completed coding user preference capability. Initiated development of initial training course. 28 July, Completed testing multi-user capability. Completed initial version of users manual.

August, 1995 -- 1-20 August, Conducted detailed review of critical path in integrated Microsoft Project file to eliminate extraneous imposed starts and finishes, eliminate level-of-effort items from critical path, and other quality checks to improve validity of critical path analysis. 8 August, Delivered SSFF MIS Enhanced Version Implementation Plan on schedule. 10 August, Installed MIS on server at MSFC. 13 August, Installed first users with access to SSFF MIS. 15 August, Conducted demonstration for system users. 20 August, Completed final version of training material for training SSFF MIS users. 25 August, Initiated user training.

September, 1995 -- Continued reviewing individual WBS schedules with WBS managers and incorporating changes. Continued effort to develop automated integration of WBS managers' schedules into single consolidated file. Continued development of enhancements in accordance with enhancements schedule. Also documented all known bugs/fixes/incomplete items, made specific personnel and time assignments for incorporation into MIS. 1-7 September, Completed MIS Training for SSFF MIS users. 19 September, Reviewed schedule critical path with Program Office personnel. 20 September, Successfully opened 17 separate Microsoft Project files of approximately 5,000 activities each, extracted individual WBS Managers' areas, and created new combined file. This did not include any interlocking logic between WBS Managers' areas of responsibility.

October, 1995 -- Continued reviewing individual WBS schedules with WBS managers and incorporating changes. Continued effort to develop automated integration of WBS managers' schedules into single consolidated file. Continued development of enhancements in accordance with enhancements schedule. Also documented all known bugs/fixes/incomplete items, made specific personnel and time assignments for incorporation into MIS. Completed development of the Contract List screen, Detailed Contract screen, Contract List Report, and Detailed Contract Report. Also completed development of the Procurement List screen and report and the Detailed Procurement screen and report. These were part of the link to the Marshall procurement system. 5 October, Cost and schedule estimates for certain enhancements were provided as requested by the Program Office. 10-20 October, Completed the administrative portion of schedule consolidation function. This would allow the schedule administrator to define which WBS Managers' files will be used in creating the consolidated schedule. 18-20 October, Produced several macros within Microsoft Project to assist the schedule administrator. Some were related to the schedule consolidation process. One exhibited progress against the baseline Gantt bar rather than against the current schedule bar. 20 October, Generated list from most current consolidated schedule file of all logic which crosses between WBS Managers' areas of responsibility. This list was used to identify "Interface Milestones" for future consolidation of separate files. 20 October, Completed the "Links Administrator" which allows the schedule administrator to add, delete, change, and administer the interface milestones and their connecting logic.

November, 1995 -- Continued reviewing individual WBS schedules with WBS managers and incorporating changes. Continued effort to develop automated integration of WBS managers' schedules into single consolidated file. Continued development of enhancements in accordance with enhancements schedule. Also documented all known bugs/fixes/incomplete items, made specific personnel and time assignments for incorporation into MIS 1 November, Implemented the monthly update to the MIS, which included: Contract List Screen, Detailed Contract Screen, Procurement List Screen, Detailed Procurement Screen, Contract List Report, Detailed Contract Report, Procurement List Report, and the Detailed Procurement Report. These formed part of the linkage to the Marshall procurement system. Eventually, this area of the MIS would also include data extracted from the Automated Procurement Reporting System (APRS). 15

November, Completed development of the automated schedule consolidation function and began formal testing. This involved sending consolidation files to Microsoft to determine why our system was "crashing", even though we had exhausted every avenue in determining that the .MPX files we had created were without error. We were advised by Microsoft that indeed our files were flawless, but that there is an "undocumented limitation" in the size of file which *Project* can open from the .MPX format, and that we had exceeded that limit. The solution to this problem, we were advised, was to perform the schedule consolidation on Version 4.1 of Microsoft *Project* for Windows 95. We procured a copy of this upgrade, and, indeed, the consolidation process did go to completion. 18 November, Completed development of the Aggregate Breakdown Structure capability and continued testing and refinement. This capability enables users to select data in a format which "crosses" the vertical branches of the WBS and summarizes the workforce and cost data in alignment with the Product Development Teams or "Cost Accounts."

December, 1995 -- Continued reviewing individual WBS schedules with WBS managers and incorporating changes. Continued work on minor checklist items as they were pointed out. 14 December, Met with Program Office personnel and Contracting Officer to discuss growth and changes in the MIS development effort. Agreed that Camber would append the SOW to reflect the actual direction of the ongoing effort, and that this SOW, when agreed upon by the Program Office, might become part of an unsolicited proposal by Camber. A specific format for providing cost impact requirements was also provided to Camber by the Contracting Officer. 15 December, Modified user preference to include Aggregate Breakdown preference. 15 December, Implemented PROMIS requirements for closed PR's. 15 December, Completed "drill down" feature for Aggregate Breakdown. 18 December, Completed testing of automated schedule consolidation software. This was to have been installed at MSFC in a December delivery. In light of the Government furlough, Camber anticipated it would be included in the January delivery. 22 December, Completed code which insures that when changes are made in the WBS, the WBS and WBS_REF tables are correctly updated and also that data in those tables is updated to accommodate the structure changes. Also included the necessary safety features which protect the integrity of the data.

January, 1996 -- Continued reviewing individual WBS schedules with WBS managers and incorporating changes. Continued work on minor checklist items as they were pointed out. Completed coding the Change Authorization function, less the Re-Baseline option, which required some further testing. Updated Total Program Logic Network to incorporate Federal holidays (at Program Office direction). Also updated the network to include baseline dates for all activities (many activities were previously without baseline dates). This was done in accordance with rules for retroactive baselining established by Mr. Linskey. Created PowerMac version of SSFF-MIS. Previously, PowerMac users had used the standard Macintosh executable of the SSFF-MIS. This enhancement represented a 40% improvement in performance for PowerMac users. 16 January, In accordance with agreements made at December contracts meeting, provided revised Statement of Work to Mr. Andrew Linskey of SSFF Program Control. He agreed to review this document and notify Camber when he was ready to discuss it. Also provided copy of a revised implementation plan which reflects the contents of the revised SOW. 25 January, Delivered latest updated version of SSFF-MIS. The Program Office specifically requested that the schedule consolidation function not be made operable in the delivered version of the MIS until they have had an opportunity to test it. This is being scheduled for February.

February, 1996 -- Continued reviewing individual WBS schedules with WBS managers and incorporating changes. Continued work on minor checklist items as they were pointed out. Met

several times with Program Control to discuss possible contract modifications and an extension of the contract. 9 February, Demonstrated schedule consolidation process to Monica Hammond. System failed to consolidate a logic network which she provided. Camber later determined and corrected cause. A follow-on demonstration was scheduled for 8 March. Delivered "Scheduling Handbook" to Program Control for review and comment. 16 February, Completed synchronization of password with WPS password. 19 February, Completed placing variance summary box on Workforce Performance Histogram report. 20 February, Received Modification 3 to the contract, adding $75K provisional funding and extending the period of performance to June 25, 1996. 22 February, Completed capability to modify Change Package data after initial input. Also completed coding the Re-Baseline option of the Change Authorization function. Delivered February update to the SSFF-MIS.

March, 1996 -- Continued reviewing individual WBS schedules with WBS managers and incorporating changes. Continued work on minor checklist items as they were pointed out. Met several times with Program Control to discuss possible contract modifications and an extension of the contract. 26 February through 1 March, Demonstrated Change Authorization process in MIS to Program Control personnel and selected WBS managers. 8 March, Attempted again to demonstrate schedule consolidation process to Monica Hammond. System failed to consolidate a logic network which she provided. Camber later determined and corrected the cause. A follow-on demonstration is scheduled for 5 April. Completed and began testing the corrected code for calculating CYT and YTD workforce and funding totals after incorporation of changes. Completed coding of modifications to variance box display allowing for more items, adding a percentage column, having an organization breakout, and sorting by WBS/ABS/Org. 9 March, Completed putting variance summary box on funding performance histogram report. 13 March, Modified the monthly import process to handle cases where monthly actuals are received prior to the calendar end of the month. 22 March, Received Modification 4 to the contract, adding $50K provisional funding. Also completed coding and began testing a summary report for change packages.

April, 1996 -- Reviewed individual WBS schedules with WBS managers and incorporated changes. This work is transitioning to Program Office personnel. Continued work on minor MIS checklist items as they were pointed out. Met several times with Program Control to discuss possible contract modifications and an extension of the contract. Also met weekly to review status of ongoing design and code development relating to import and display of manufacturing data. 1 April, Met with M&P to discuss data elements to be transferred in manufacturing information. 2 April, Completed modifying import process to allow for Support Contractor (OBS>1.0) data. 5 April, Successfully demonstrated schedule consolidation process to Monica Hammond, using schedule data which she provided. She indicated she would report this success to Program Control, but would probably not recommend routine use of this software for monthly schedule consolidation. 8 April, Completed code which maps WBS to procurement (PROMIS) data. 13 April, Completed both Detail and Summary IMPACS reports. Added these under the Schedule menu. 17 April, Completed coding of schedule trend input and output screens and reviewed with Program Office personnel. Incorporatedchanges recommended. 19 April, Completed input screen coding for input of support contractor plan and actual data. We would complete testing of this function in May using real support contractor data.

May, 1996 -- Entire month -- Continued work on minor checklist items as they are pointed out. Modified code which imports data to include IMPACS and APRS data. Also, modified the import code to make it more user-friendly.

15 - 25 May - Rewrote several macros associated with the SSFF's use of Microsoft Project. Effort focused on speeding up processing time and making them more convenient through the use of "buttons" to invoke individual macros. 20 May, Met with Karen Johnson to clarify requirements for APRS data. 22 May, Received APRS data. 23 May, Demonstrated the IMPACS module to SSFF management. 29 May, Met with ISSO to discuss SSFF MIS configuration and mechanics of importing data. 30 May, Demonstrated the capability to add new projects to SSFF management. The issue was raised that the need also existed to create "blank" Microsoft Project files for a new project. These files must contain the formats, filters, views, tables, macros, and toolbar buttons which had been created for SSFF.

June, 1996 -- Continued work on minor checklist items as they were pointed out. Modified code which imports data to include IMPACS and APRS data. Also, modified the import code to make it more user-friendly. 4 June, Delivered updated SSFF-MIS Application. 12 June, Delivered updated SSFF-MIS Application. 13 June, Met with Sharon Wright to clarify data sources for various portions of APRS Report. 20 June, Conducted demonstration of procurement area of SSFF-MIS to Program Control personnel. 21 June, Completed procurements module, also completed "Health Screen" to include "at complete" values. 26 June, Completed modification adding WBS and ABS selection to procurement module. 27 June, Conducted demonstration of open PROMIS area of SSFF-MIS to Program Control. 28 June, Completed modifications to Funding Plan Entry screen to include scrolling summary box.

July, 1996 -- Continued work on minor checklist items as they were pointed out. Modified code which imports data to include IMPACS and APRS data. Also, modified the import code to make it more user-friendly. 3 July, Completed modification incorporating ABS selection in IMPACS module.

August, 1996 -- Continued work on minor checklist items as they were pointed out. Continued to modify the import code to make it more user-friendly. 2 August, Successfully performed data import using Macintosh. 2 August, Provided yearly totals, all-year summaries, and total FY FTE in Support Contractor Reports. 3 August, Completed Plan Archive function. 6 August, Completed Plan Rename function. 8 August, Completed redesigned IMPACS screens. 9 August, Met with Jean Rayhle to discuss changes to priorities of data sources for IMPACS data. 13 August, Completed capability to conveniently display Usage Data. Successfully tested Camber's recommended solution to problem with Macintosh printer interface (Installation and removal of FoxPro 2.6 for Macintosh). 14 August, Completed modifying WBS-ABS transition for consistency in transition. 15 August, Completed "Tracking Milestones" menu item. 15 August, Delivered copies of FoxPro 2.6 for Macintosh and Doc-to-Help Software. 20 August, Met with Sharon Wright to discuss sources of historical PROMIS data. 21 August, Modified variance boxes in reports to match categories of data in reports. 26 August, Released new version of SSFF-MIS. 27 August, Released update to new version of SSFF-MIS. 29 August, Provided ABS Selection in Personal View.

September, 1996 -- Continued work on minor checklist items as they were pointed out. Continued to modify the import code to make it more user-friendly. 3 September, Provided yearly report capability in funds/workforce areas of menu. 4 September, Completed modifications to Procurements Report for consolidated DCNs and other items defined by Program Control. 5 September, Provided annualized graphs in funds/workforce. 6 September, Added C/S - Contractor toggle on workforce reports and graphs. 12-27 September, Conducted comprehensive system testing. 13 September, Completed support contractor plan entry summarization capability. 16 September, Completed modifications to the data import function to

provide fewer opportunities for operator error. 16 September, Completed modifications to formats of yearly name runs. 16 September, Completed adding security level allowing editing of saved plans. 19 September, Completed training of Project personnel. 27 September, Received Modification 11 to contract authorizing the development of a System Design Document and maintenance of the system through 30 November 1996. 30 September, Delivered final Users Manual, Scheduling Handbook, Schedule Consolidation Handbook, System Administrator's Handbook, SSFF-MIS application code.

October, 1996 – Completed and delivered the SSFF System Design Document. Delivered the document on 22 October, on schedule.

The system is in use to a limited extent by both the Reusable Launch Vehicle (RLV) and Advanced Space Transportation Program (ASTP) Project Offices. This is encouraging, since the contract required that the SSFF-MIS be usable by other projects with similar requirements to those of the SSFF project.

Lessons Learned:

1. This contract started out to be a level-of-effort services contract to develop an MIS. It was changed to a product-oriented contract. Because of the dynamic nature of an MIS design, it might have been more effective to have left it as a level-of-effort contract. It is almost impossible to anticipate and describe in advance all the subtleties and nuances of a complex MIS. Therefore, the Statement-of-Work can never fully anticipate the exact nature of the work to be done over an 18- or 22-month development process. In the future, we would probably recommend the use of a level-of-effort contracting vehicle. It would avoid the overhead effort of constantly defining and redefining the job, re-estimating discrete elements of work, concern over in- and out-of-scope effort, etc.

2. The "baggage" of having to accommodate both Macintosh and IBM-PC's is very costly and never works to everyone's satisfaction. The two operating systems have enough fundamental differences that no application of this complexity can truly be "transparent" to both platforms. For example, the interface between the MIS code and Microsoft Project makes use of Dynamic Data Exchange (DDE), but DDE doesn't exist in the Macintosh environment. Certain infrequently used features (such as schedule import) will only operate in the PC environment. It would have been nice if all features could have been fully transparent, but certain compromises had to be made in the interests of speed and practicality. Future efforts of this type can be made more effective if the user community will make an up-front decision to use only one system – MAC or PC.

3. One of the requirements of this contract was that it be usable by Government personnel. This is true only as long as the Government is willing to require appropriate credentials and provide adequate training to its specified system administrators/managers.

It is impossible to design a system as comprehensive as the one required under this contract and to keep it uncomplicated and straightforward. By its nature, it is complicated and very demanding in its administration. It imports diverse data from multiple sources. Often, these sources are changed without prior warning. The data doesn't import as expected. The database is large and complex. The interface to Project is rigorous and requires discipline on the part of schedulers. The system demands discipline in the development of Work and Organizational structures and in relating them to accounting codes. These relationships affect the validity and

accuracy of reports. For future developments of this type, we would recommend the assignment of database-literate Government personnel with extensive exposure to database applications as system administrators.

4. The Government normally does not assign a COTR who is the same individual who originated the requirements of the contract.[1] In the case of the SSFF-MIS, this was the case. We would recommend against it in the future. Too often, in discussions regarding the content of the Statement of Work, we were met with, "It was always our intent...," "It has always been our understanding...," or other phrases which assumed the broadest possible interpretation of a certain phrase or clause in the Statement of Work. Unfortunately, this situation left Camber no option but to submit a constructive change proposal, an option which neither the Government nor the contractor enjoys pursuing. We believe that a third party COTR would have been more capable of objective evaluation of and interpretation of the words contained in the SOW.

5. The schedule for the development of the MIS assumed success in both code development and in the availability and dependability of source data. It was optimistic in both regards.

[1] Sondra L. Strunk, "The Contracting Officer's Technical Representative," *Contract Management*, 36:9, p.48, September, 1996

Attachment A: Comments by the Contracting Officer's Technical Representative

National Aeronautics and
Space Administration
George C. Marshall Space Flight Center
Marshall Space Flight Center, AL 35812

Reply to Attn of: FA26 (96-031)

November 18, 1996

Camber Corporation
Attn: Ms. Lisa Hubbard
635 Discovery Drive
Huntsville, AL 35806-2801

SUBJECT: Contract NAS8-39990/7700-94-2563

The report entitled "Final Report - Space Station Furnace Facility Management Information System (SSFF-MIS) Development," which Camber submitted on November 12, 1996, is approved under the condition that the following comments are incorporated:

1. Page 3, Second Paragraph, Last Sentence - Change to read "The Program Office would not state whether to continue or not. Their response was 'We always expected scheduling support until the MIS could provide an automated scheduling capability which was to have been available last August. Camber is responsible for managing both cost and schedule, and not one to the exclusion of the other. It is your decision.'"

2. Page 7, Paragraph for November 1995 - Add as last sentence "Notified the Program Office that the contract cannot be completed within budget and schedule. 2 November, Reviewed our latest cost and schedule estimate with the Program Office which reflected a need for an additional $151K and approximately four additional months (from March 7 to June 25, 1996) in order to complete the contracted effort.

3. Page 9, Paragraph for March 1996 - Modify next to last sentence to read "22 March, Received Modification 4 to the contract, adding $50K provisional funding and deleting MIS requirements associated with S&MA, Risk Management, and Technical Performance in order to reduce cost."

4. Page 10, Paragraph for July 1996 - Add as last sentence, "12 July, Experienced another failure with the schedule consolidation module during a demonstration to A. Linskey. Consequently, when asked, recommended to A. Linskey that the Project not use automatic schedule consolidation because of its 'fragility.'"

5. Page 11 - Change "Lessons Learned:" to "Lessons Learned (The COTR does not agree with subparagraphs 1 and 4):"

6. Page 11, Paragraph 1 - Change the first sentence to read "This contract was a product-oriented contract." Delete the second sentence. Change the third sentence to read "Because of the dynamic nature of an MIS design, it might have been more effective if it had been a level-of-effort contract."

7. Page 12 - Add "6. COTR's lesson learned: The contractor's project manager, instead of just someone in marketing (as was the case on this contract), should have participated with the COTR in the development of the Statement of Work so that the project manager would have clearly understood his customer's requirements reflected therein, priced and scheduled these requirements accordingly, and therefore have full ownership of all aspects of the contract instead of an inheritance."

8. Page 12 - Add Another Section As Follows:

"Conclusions (provided by the COTR):

The SSFF MIS is a very good tool. However, there are opportunities for improvements and for additional enhancements. The Funding and Workforce areas are extremely good. What has been done in the Procurement and the Manufacturing areas of the MIS are good. Procurement is an area whose potential has not been explored fully, particularly as related to project schedule correlation, vendor forecasted delivery dates, delivery notifications and exception reporting. The Manufacturing area may be need some fine tuning, because of its late implementation; it also has significantly more potential for enhancements. Cost and Schedule Trending is good; however, viewing Tracking Milestones is cumbersome and awkward. The Schedule area is weak. It does not meet expectations but is useable.

Some known potential enhancements include three desirable MIS features that were reluctantly deleted as a requirement from the MIS contract. These deleted features were: 1) the capability to interface with the Safety and Mission Assurance systems, such as the Problem Reporting and Corrective Action System (PRACA), and to obtain status of Certificates of Qualification and Alerts; 2) the capability to perform Risk Management; and 3) the capability to measure technical performance accomplishment against specification requirements and plans.

Additionally, there are areas which offer opportunities for improvements. An acknowledged serious shortcoming is with the MIS scheduling system, which utilizes Microsoft Project. The system cannot provide a logically linked, integrated baseline schedule, which is very critical to Project Management. The system permits baseline tasks to be added or changed illogically, which affects baseline credibility. Extreme care is required when adding new work or when replanning future baseline tasks, in order to maintain the proper relationships within schedule constraints - and is a manual effort.

Also, the attempt to develop an automated scheduling system, which was a primary goal of the SSFF MIS, was unsuccessful. In this system, detailed electronic schedules (including schedule updates and schedule status) would have been maintained by individual Work Breakdown Structure Managers and which would have been consolidated automatically into the detailed integrated Project Schedule. The system also would have automatically notified a WBS Manager when his schedule update impacts another WBS Manager, which he must resolve before consolidation can occur. Consequently, the resulting scheduling system is simply one which uses Microsoft Project with macros for customized formats and reports, and inherently requires significant manual intervention. Currently, there are no

specifically known operational problems with automatic schedule consolidation as the contractor has implemented it, but experience has shown that it is subject to failure. The SSFF Project concurs with the Development Contractor's recommendation not to use the automatic consolidation process because of its "fragility." Users have been warned not to use this function except for experimentation and for further development of automatic schedule consolidation.

Another improvement would be to use the full capability of the WBS hierarchy scheme so that information can be summarized across all projects and all organization from within the MIS, with the assignment of each user project to a separate branch of the WBS.

Additional enhancements could include a Project Inventory Control System for purchased hardware/components, the incorporation of earned value, and resource loaded scheduling. Unquestionably, there are more candidate enhancements known to other MIS users and to non-users.

A driving and uncompromising principle in the development of this MIS and for its future maintenance is that all MIS capabilities and all enhancements, regardless of who initiates them, will be available for all to use and that the MIS shall be placed under strict configuration control for the benefit and security of its users. Toward this end, the MSFC Office of the Chief Financial Officer (CFO) has assumed the responsibility for the management and configuration control of the SSFF MIS. Likewise, as of December 1, 1996, the MSFC Information Systems Support Office (ISSO) and its Automatic Data Processing (ADP) contractor will be responsible for the operation and maintenance, including enhancements, of the SSFF MIS."

Please update the Final Report to include the above comments before the contract concludes on November 30, 1996.

Andrew F. Linskey

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MIS Contract COTR
Space Station Furnace Facility Project

cc:
Camber/ Mr. Mead
GP37/Ms. Alexander

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13. ABSTRACT: Contractor's summary of contractual and technical chronologies and lessons learned. Attachment A contains additions, corrections, and deletions by the COTR.

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